the electrodes of all dust, and seems to dispel all dust from the gas through which the discharge occurs. It is well known that an electric discharge in a vessel of air has the effect of clearing out of the air all the particles that serve as nuclei for the condensation of water; and we made several experiments with a view to determine whether a similar effect was produced on the dust in our tubes. The gas from the sparking tube was carried through a glass globe, and so on to the jet where it was burned; a wire connected with one pole of a Voss or Wimshurst electric machine projected into the interior of the globe, and a patch of tinfoil on the outside of the globe was connected with the other pole of the electric machine. So long as the Voss machine was not worked, the gas carried the dust from the sparking tube through the globe, and it was seen in the spectrum of the flame, or simply in the colour of the flame when lithium was one of the electrodes; but, on working the machine so as to produce a silent discharge inside the globe, the flame, in one or two seconds, suddenly ceased to show the spectrum of the dust, and in the case of the lithium lost its red colour. When the machine was no longer worked, the spectrum or colour speedily reappeared, to vanish again suddenly when the machine was started afresh. When a narrow tube, with a piece of tinfoil outside and a wire inside, was substituted for the globe, the like results ensued.

It appears, then, not only that dust, however fine, suspended in a gas will not act like gaseous matter in becoming luminous with its characteristic spectrum in an electric discharge, but that it is driven with extraordinary rapidity out of the course of the discharge. If, then, the spectrum of the aurora be due, not to the ordinary constituents of our atmosphere, but to adventitious matter from planetary space, we conclude that such matter must be in, or must be brought into, the gaseous state, or at least have its properties entirely altered from those it possesses at ordinary temperatures, before it becomes luminous in the electric discharge.

III. "On the Specific Heats of Gases at Constant Volume. Part I. Air, Carbon Dioxide, and Hydrogen." By J. Joly, M.A., B.E., Assistant to the Professor of Civil Engineering, Trinity College, Dublin. Communicated by Professor Fitzgerald, M.A., F.R.S., F.T.C.D. Received September 2, 1890.

(Abstract.)

In this first notice the specific heats, at constant volumes, of air, carbon dioxide, and hydrogen are treated over pressures ranging from 7 to 25 atmospheres. The range of temperature is not sensibly

varied. It is found that the specific heats of these gases are not constant, but are variable with the density. In the case of air the departure from constancy is small and positive; that is, the specific heat increases with increase of the density. The experiments afford directly the mean value 0·1721 for the specific heat of air at the absolute density of 0·0205, corresponding to the pressure of 19·51 atmospheres. A formula based on the variation of the specific heat with density observed in the experiments ascribes the value 0·1715 for the specific heat at the pressure of one atmosphere. The formula assumes the specific heat to be a linear function of the density, which must as yet be regarded only as an approximation, the exact nature of the relation being concealed by variations among the experiments.

These results appear to be in harmony with the experiments of Wiedemann on the specific heat at constant pressure, and of Rowland on the mechanical equivalent of heat, from which the value 0·1712 is deduced for C_v at 760 mm.

The experiments on carbon dioxide reveal a more rapid variation of the specific heat with density, the variation in this case being again positive in sign. The formula

$$C_v = \rho \times 0{\cdot}2064 + 0{\cdot}16577$$

appears with considerable reliability to express the relation between specific heat and density.

The relation between specific heat and density in the case of hydrogen is of a negative character; that is, the specific heat diminishes with increase of density. The experiments are chiefly directed to elucidate this point, for, owing to the difficulty of preparing pure hydrogen, it was found that variations in the quantitative results of experiments on different samples of the gas were unavoidable. Accordingly the experiments were directed to a comparison of the specific heats of like samples of the gas at different densities. The variation with density is small, but (with one exception) all experiments on the purer hydrogen ascribe a negative character to it.

The nature of these variations of specific heat with change of density is, in the case of the three gases, in accord with their behaviour as regards Boyle's law, within the limits of pressure.

The experiments were effected in the steam calorimeter, a differential method being used in which an empty or idle vessel is thermally compared with the vessel holding the gas at high pressure. The vessels possessing approximately the same calorific capacity, the result, theoretically, is as if the gas was dealt with isolated from any containing vessel. Although practically this is not attained, many sources of error are eliminated by the procedure adopted.